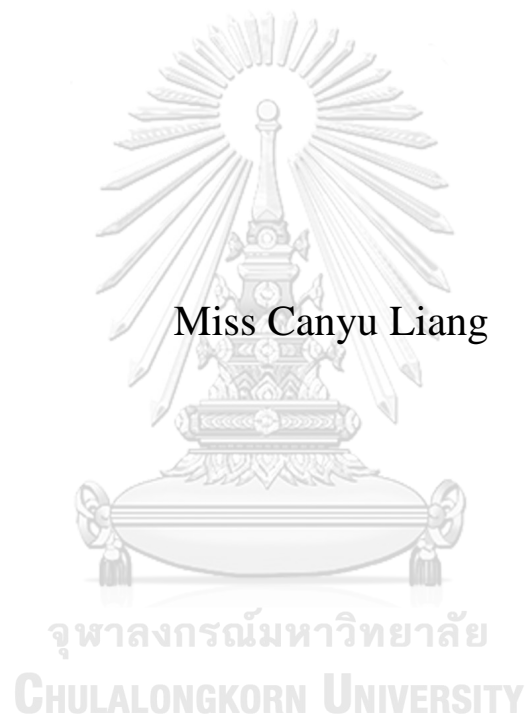


# Air pollution by motorcycles in big cities: the case of Bangkok



An Independent Study Submitted in Partial Fulfillment of the  
Requirements  
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Inter-Department of Southeast Asian Studies  
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ปีการศึกษา 2562  
ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

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By                                      Miss Canyu Liang  
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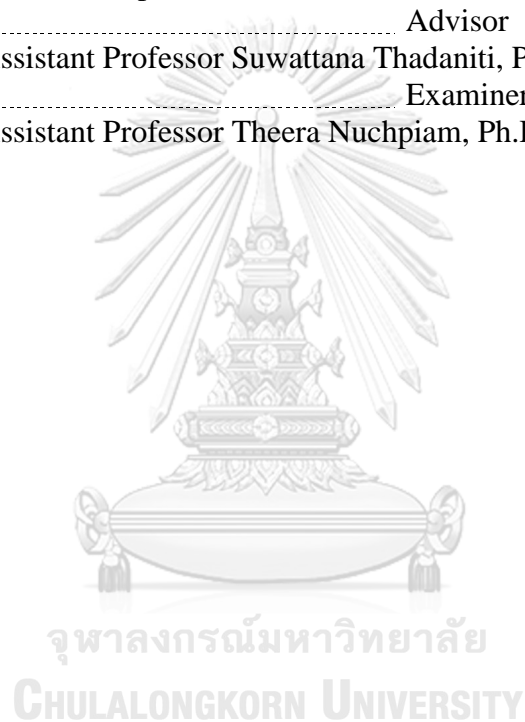
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INDEPENDENT STUDY COMMITTEE

..... Chairman  
(Saikaew Thipakorn, Ph.D.)

..... Advisor  
(Assistant Professor Suwattana Thadaniti, Ph.D.)

..... Examiner  
(Assistant Professor Theera Nuchpiam, Ph.D.)



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ศศ. ดร.สุวัฒนา ธาดานิติ

กรุงเทพมหานคร นครระดับนานาชาติและเป็นเมืองหลวงของประเทศไทย ในหลายปีมานี้ปัญหามลพิษของประเทศไทยกำลังรุนแรงมากขึ้นเรื่อย ๆ สารนิพนธ์นี้มีจุดมุ่งหมายที่จะสืบค้นต้นตอของปัญหา เหตุใดประเทศไทยจึงประสบปัญหามลพิษ ซึ่งไม่เคยมีการสำรวจว่ารถจักรยานยนต์ส่งผลกระทบต่อมลพิษในอากาศอย่างไร และเพื่อแสดงให้เห็นถึงปัญหาหลักของมลพิษ รวมทั้งวิเคราะห์ว่าเหตุใดรถจักรยานยนต์จึงเป็นตัวแปรสำคัญ เมื่อเราต้องการที่จะอนุรักษ์สิ่งแวดล้อม ระเบียบขบวนการที่ใช้ในการวิเคราะห์ประเด็นเหล่านี้ คือ การใช้แบบสอบถามเพื่อรวบรวมทัศนคติของประชากรในกรุงเทพมหานคร



สาขาวิชา      เอเชียตะวันออกเฉียงใต้ศึกษา  
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ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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Canyu Liang : Air pollution by motorcycles in big cities: the case of Bangkok. Advisor: Asst. Prof. Suwattana Thadaniti, Ph.D.

Bangkok is an international metropolis and the capital of Thailand. In recent years, the problem of air pollution in Thailand has become more and more serious. This paper aims to explore the reason why Thailand suffered from haze problem, which it has not before and explore how motorcycles affect air pollution. And to show the main sources of pollution, analyze why motorcycle plays an important role when we want to protect the environment. The methodology to analyze these issues is to use questionnaires to get the attitudes of people in Bangkok.



Field of Study:	Southeast Asian Studies	Student's Signature .....
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Canyu Liang

## TABLE OF CONTENTS

	<b>Page</b>
ABSTRACT (THAI) .....	iii
ABSTRACT (ENGLISH).....	iv
ACKNOWLEDGEMENTS.....	v
TABLE OF CONTENTS.....	vi
Background .....	1
Haze is traditionally an atmospheric phenomenon in which dust, smoke, and other dry particulates obscure the clarity of the sky. Sources for haze particles include farming (plough in dry weather), traffic, industry, and wildfires. ....	1
The air pollution in Bangkok in general .....	3
The reason why Bangkok has the haze problem.....	3
Population density.....	4
Traffic jam .....	4
job opportunities and education resources .....	5
Garbage burning.....	6
The characters of Thai people.....	6
The pollution in Chiang Mai compared to in Bangkok.....	7
Pollution made by motorcycle .....	11
Interview academic .....	11
Interview fast food seller .....	12
Interview students .....	13
Conclusion and recommendation.....	19
Author's opinion.....	19
Recommendation to reduce air pollution.....	20
REFERENCES .....	24
Appendix .....	26

The questionnaire of interview .....	26
VITA.....	27





# Background

Haze is traditionally an atmospheric phenomenon in which dust, smoke, and other dry particulates obscure the clarity of the sky. Sources for haze particles include farming (plough in dry weather), traffic, industry, and wildfires.

PM<sub>2.5</sub> refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers, which is about 3% the diameter of a human hair. Since they are so small and light, fine particles tend to stay longer in the air than heavier particles. This increases the chances of humans and animals inhaling them into the bodies. Owing to their minute size, particles smaller than 2.5 micrometers are able to bypass the nose and throat and penetrate deep into the lungs and some may even enter the circulatory system. Fine particles can come from various sources. They include power plants, motor vehicles, airplanes, residential wood burning, forest fires, agricultural burning, volcanic eruptions and dust storms.

Studies have found a close link between exposure to fine particles and premature death from heart and lung disease. Fine particles are also known to trigger or worsen chronic disease such as asthma, heart attack, bronchitis and other respiratory problems.

Due to the many adverse effects fine particles can inflict on a large number of people, PM<sub>2.5</sub> is one of the major pollutants closely monitored by health authorities around the world. We always use PM<sub>2.5</sub> alongside the Air Quality Index (AQI) or

Pollutants Standards Index (PSI) as the air quality standards to judge air pollution level.

The table below will show what levels of PM2.5.

#### 24-Hour PM<sub>2.5</sub> Standard (µg/m<sup>3</sup>)

PM <sub>2.5</sub>	Air Quality Index	PM <sub>2.5</sub> Health Effects	Precautionary Actions
0 to 12.0	<b>Good</b> 0 to 50	Little to no risk.	None.
12.1 to 35.4	<b>Moderate</b> 51 to 100	Unusually sensitive individuals may experience respiratory symptoms.	Unusually sensitive people should consider reducing prolonged or heavy exertion.
35.5 to 55.4	<b>Unhealthy for Sensitive Groups</b> 101 to 150	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.	People with respiratory or heart disease, the elderly and children should limit prolonged exertion.
55.5 to 150.4	<b>Unhealthy</b> 151 to 200	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.	People with respiratory or heart disease, the elderly and children should avoid prolonged exertion; everyone else should limit prolonged exertion.
150.5 to 250.4	<b>Very Unhealthy</b> 201 to 300	Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.	People with respiratory or heart disease, the elderly and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.
250.5 to 500.4	<b>Hazardous</b> 301 to 500	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children should remain indoors.

1

On around 30<sup>th</sup> January this year, Bangkok shut hundreds of schools because of

<sup>1</sup> Source: [U.S. Environmental Protection Agency](#)

toxic haze.

But why we need to care about the haze problem? To know this answer we should know who's suffering from the haze? The answer is anyone living in the affected areas will suffer from the haze. Therefore, haze problem is related to everyone and that is why I conduct this research.

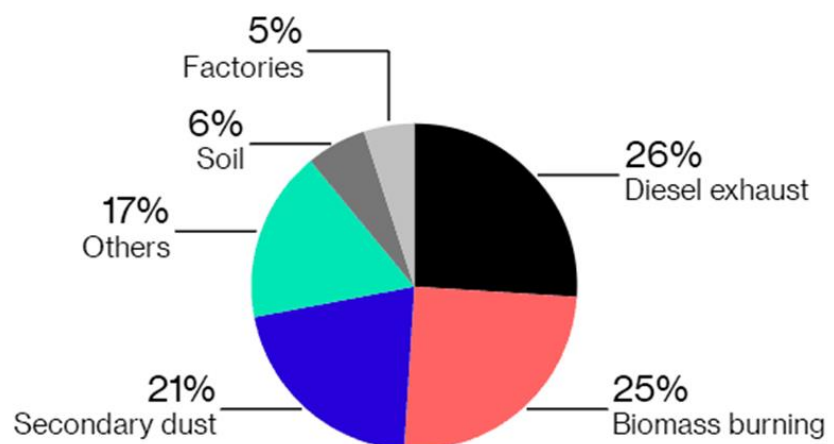
## The air pollution in Bangkok in general

### The reason why Bangkok has the haze problem

We can get the reason why Bangkok has the haze problem from this picture.

#### **Bangkok: City of Smog**

Main contributors of PM2.5 pollution in the capital



Source: Siam Commercial Bank's Economic Intelligence Center, Energy Policy Institute at University of Chicago

We can see clearly from the chart that the main reason that the haze happened

was from the vehicle emissions (diesel exhaust, 26%). But to explain it deeper, what makes vehicle emissions worse? The reason can be given below.

## **Population density**

Population density has a significant positive impact on haze pollution, indicating that the impact of population density on haze pollution is mainly reflected in the scale effect. The increase in population has led to an increase in housing demand, which has led to a large amount of dust in the construction of buildings. At the same time, the increase of population will also stimulate the demand for cars, resulting in traffic congestion and a large number of vehicle exhaust emissions.

## **Traffic jam**

Speaking of traffic in Bangkok, Bangkok's traffic jam problem is one of the worst in the world. The reasons for this phenomenon are as follows:

First, Bangkok's road planning has not kept pace with the speed of urban expansion, so many roads are too narrow to withstand the current traffic flow.

Second, in order to promote economic development, the government encourages people to buy more private cars. The increase of vehicles also leads to the deterioration of the air.

Third, public transport with less environmental pollution is not very developed or a little expansive.



## job opportunities and education resources

There are many people from other provinces working in Bangkok because Bangkok as the central center has more job opportunities and better education resources. In order to improve the quality of family life, they will choose to work in Bangkok, return home from Bangkok on rest days, and even some people have to drive between Bangkok and other provinces every day. That's why all drivers are afraid of traffic on Friday and Sunday nights, because it's so crowded, and the emissions from cars are horrible.



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<sup>2</sup> Source : <https://images.app.goo.gl/Cx1H63hqUqqewnVM9>

## Garbage burning

The burning of garbage is also one of the important reasons.(others,17%)

Because of the dense city, a lot of garbage is produced, but at the same time, garbage classification and garbage recycling are not very developed. Therefore, local people and even the government have the habit of disposing garbage by incineration, which will undoubtedly aggravate the haze.



## The characters of Thai people

Through my observation of Thai people.I think the Thai character is relaxed, not in a hurry about anything and take everything easy.So they care about the environment, but they don' t pay enough attention.They hate all the troubles and prefer to maintain the status quo, so they are very reluctant to do motorcycle

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<sup>3</sup> <https://images.app.goo.gl/vLXfUDE8gShjXkZC8>

<sup>4</sup> <https://images.app.goo.gl/xgCYxpsKGgQA4ZVK6>

environmental checks or find ways to upgrade motorcycles to be more environmentally friendly. A person's disregard for the environment is not terrible, but many a little makes a mickle, the accumulation of various small pollution becomes a big pollution.

## **The pollution in Chiang Mai compared to in Bangkok**

The reason why Chiang Mai has the haze problem is because the farming burning. This is different from the air pollution in Bangkok, which is mainly caused by the car exhaust.

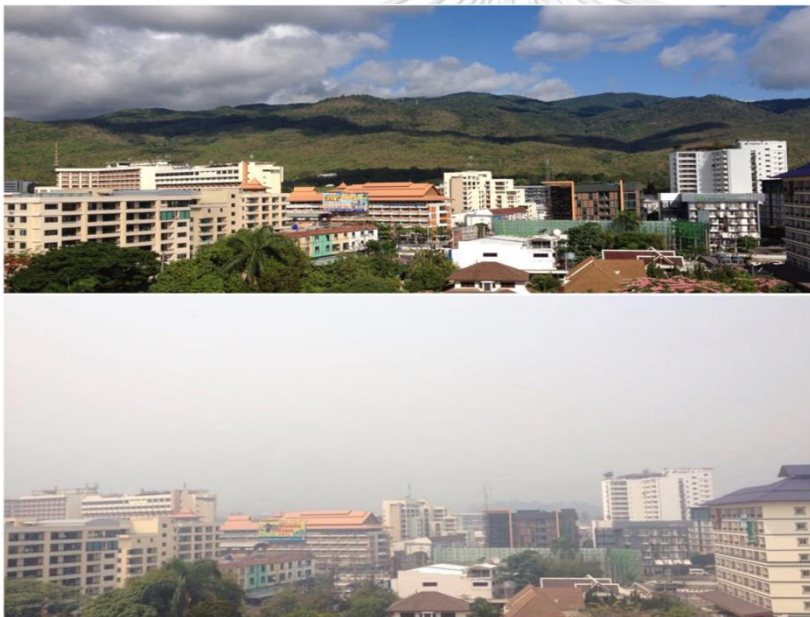
In fact, haze happened again and again every year in Chiang Mai and Northern Thailand: as the cool season draws to an end around late February or early March, the air quality quickly takes a turn for the worse. We call it “smoky season”—or known as Chiang Mai’s “burning season”.

The Chiang Mai’s haze problem is a seasonal event. The smoky season in Northern Thailand and the surrounding parts of Southeast Asia generally occurs during the months of February, March, and April. The exact timing and severity of the haze is different every year because it is dependent on human activity and the weather.

The rainy season in this region is typically over by November, and so the air can start to get hazier as early as December. It doesn’t usually become problematic, though, until late February or early March. On the tail end, the haze doesn’t fully clear until the burning stops and rains come to wash the pollution out of the sky. The real start of the rainy season isn’t until June, but there is usually enough rain in May to clear things up considerably.

Hot season flash-storms in March and April can also help provide temporary relief for a couple days. The smoky season consistently reaches its peak in the second half of March, and the air is usually much improved after the mid-April Songkran holiday. But there have been years where the hazy air has lingered on well into May.

The air in Chiang Mai is quite good for about ten months of the year. The other two, however, can frankly be quite terrible. Just compare the two photos below of Doi Suthep taken from the same vantage point—one during the rainy season and the other at the height of burning season smog.



What is the cause of the air pollution? There are three main causes of the yearly northern haze:

1. Naturally occurring forest fires
2. Intentionally set forest fires

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<sup>5</sup> Source: <https://iglu.net/survivor-guide-chiang-mai-smoky-season/>



### 3. Burning crop fields

Smoky season coincides with the tail end of the yearly dry season. By the time February and March roll around, there hasn't been any significant rainfall in the region for several months. The forests of Northern Thailand are covered with dry leaves, and wildfires can spread quickly once there is a naturally occurring or accidental spark.

There are also many man-made forest fires at this time of year. Some are set to clear land for planting corn and other cash crops on mountain slopes. Some are set to clear underbrush in order to encourage the growth of rare, prized mushrooms. Others are set to trap wild boar and other game animals.

Down in the valleys, farmers burn the rice straw and corn stalks leftover from the previous harvests in preparation for the next planting.

The mountainous terrain of Northern Thailand causes the smoky air to stay trapped in the valleys and gradually increase in pollution levels as the dry season progresses.

The bordering areas of Myanmar and Laos face the same problem. They have similar terrain and similar human and natural causes that add to the total air pollution level in the region.

Although sugar cane is not extensively grown in the North, the practice of burning sugar cane fields in Central and Northeast Thailand and in Cambodia also contributes significantly to the region's pollution woes.

In all, in my opinion, Bangkok's air pollution is more serious than Chiang

Mai. Because the smog in Chiang Mai is seasonal, it only has severe haze in 2-3 months of the year. But unlike Bangkok, Bangkok has motorized cars all the way around the country, and traffic congestion is seen every day, so from this point of view, Bangkok's pollution will be longer and more serious.



## Pollution made by motorcycle

From the chart above, we can see clearly that diesel exhaust accounts for the highest proportion, which is 26%. Among all the vehicles, motorcycle is one of the most frequently used and most common motor vehicles that can be seen in the daily life.

So in this part of the paper, I will explore how the motorcycle impacts on the environment by interviewing some people in Bangkok.

### Interview academic

The first interviewer is Dr. Kim. She has a well-known knowledge background and experienced research in this area as her business card shows. She is a teacher who works in an environmental research institute, Chulalongkorn University. So she is an expert and academic in environmental areas. She thinks the main cause of haze pollution is particulate dust and the dust comes from all the vehicles, to say it further, is from the traffic. Burning plantations is clearly a very important cause of air pollution. She thinks there is less problem with garbage burning because private burning of garbage is illegal, perhaps some people in the suburbs of Bangkok will do so, but that is only a few people. She believes that industrial pollution is controlled by law, so it is not so important, but it should be noted that some factories will secretly discharge sewage in the middle of the night, so the government should increase supervision in this regard. Among all vehicles, diesel fuel-used vehicles are the main cause and cars are more serious than motorcycles. Among the diesel fuel-used vehicles, the old buses affect the air pollution most. Old motorcycles are not as

much as they were a decade ago, and it's hard to see motorcycles with black smoke in the city, maybe in rural areas will have but not in Bangkok. Thailand's current financial system makes it easy for people to get a new car or new motorcycles. People usually choose cars and motorcycles because they are more convenient and comfortable. But buses, as part of the public system, are not private, so it's hard to get updated. So Dr. Kim thinks that trucks and buses are more important reasons for pollution in Bangkok than motorcycles. She thinks the way to measure it is public should train bus-drivers rules and old buses should be replaced by new buses. In fact, the law restricting large-emission vehicles has been worked out as she knows but can the problem be improved or not, depending on whether the law can be enforced. Her advice on improving air pollution are to increase the water body and grow more trees while Bangkok is lack of green space. And set a dirty area to collect the dirty things is a good way to keep clean of city.

### **Interview fast food seller**

I also interviewed a person who cooks and sells fast food in a small shop along the street. She looks like she is in her 50s. She is the person who showed the least concern about environmental pollution in the entire interview. She said, of course, environmental protection is very important. She also knows about smog but she is very very busy every day, so she doesn't have time to think about it. She believes that the pollution of motorcycles is not very serious, and the problem of car pollution will be more serious, because it is obvious that the number of cars is more than that of

motorcycles, and the problem of traffic jams is also because of cars rather than motorcycles. She also mentioned that many of the customers in her fast food restaurant are motorcycle drivers. Those who wear orange vests have their belonging company. Their motorcycles are less polluting. And even if the pollution of motorcycles is much, people's lives are now too dependent on motorcycles, and people will use motorcycles to delivery things, go to the place in a short time, so it is hard to reduce the number of motorcycles. She believes that a good way to reduce environmental pollution is to develop the public transportation. The more people to use public transportation, the less cars on the street, and then the less air pollution.

## **Interview students**

Mr. Andrew, the student of the graduate school, southeast Asian program. He is an American but stay in Thailand over 10 years so he can be seem as a Thailand hand. He is 52 years old but he still care very much about the current events. Therefore, he followed it very closely on the news which in January of this year, there was a serious smog problem in Bangkok. He even downloaded an App for his phone that shows the level of pollution in each area of Bangkok. When refer to the causes of environmental pollution in Bangkok. He thought there are so many causes. Like People's environmental awareness is poor and poor law-abiding awareness; the government does not pay enough attention to environmental issues; enterprises only pay attention to their own development and neglect environmental protection, the increase in population; consumption growth and environmental pollution and ecological damage in surrounding areas. He thought all the above factors play a role but the biggest issue

was air pollution from surrounding countries with poor environmental controls. He thought the biggest sources were: vehicle emissions, burning of agricultural fields, and coal power plants. When I asked how pollution comes from motorcycles in Bangkok, his answer was the older motorcycles that have poor exhaust control. However, he thought cars contribute more to pollution because of the bigger motor which uses more gas while motorcycles are smaller and more efficient. So the way to reduce the pollution of motorcycles to the environment is to get rid of the older motorcycles, or make them upgrade the exhaust systems. people should also be required to have their motorcycles inspected every year or so to make sure it is not polluting too much. The way to stop the pollution happen again that he think is to control the burning of agricultural fields, upgrade the old diesel buses in Bangkok, and implement controls on the older motorcycles as earlier mentioned. The question what areas do we think should strengthen environmental protection, his answer was stronger laws will have the most impact. Only if heavy polluters are punished will they adjust their behavior. The encourage public participation in environmental activities is important too, because the public should get involved. If public opinion is strong enough, the government will have to change its policies.

Mr.Robert, another student from southeast Asian study, 25 years old. He was aware of the haze problem since it was talked about a lot in the media and his breathing became more difficult. But he did not pay attention to discussions on the causes or solutions to the problem. he assumed the causes for environmental pollution are excessive congestion and waste and inadequate waste management. Waste gets stuck in places, like the storm drains, which can increase the chance of flooding and makes the water even dirtier. Other reasons, he would say, could be the type of fuel

used. Oil and natural gas are destructive to the environment, and Thailand does not use much cleaner alternatives. Hydroelectric dams in the northern areas and Laos increase the severity of flooding down south, even to Bangkok. Solar panel fields are limited, and he is not sure about wind farms. Nuclear energy is not available, and that may be the most efficient energy source. The public sector might be too unresponsive to environmental threats. he does not know how, but it could be over reliance on the private sector that gets in the way. The private sector just focuses on profits, so development is slow and inadequate. In Bangkok, he thinks cars are a big problem for air pollution. There are so many of them, and the public transportation is too limited. The connection and ease of exchanging different forms of public transport is lacking, but it may be increasing lately between the MRT and BTS. Buses seem to be left behind. Thailand is developing high speed trains, so that may help. Bangkok is in an industrial zone, so he thinks the fuel and gas emissions and waste generated has a big effect on the air. Another factor might be geographical because of wind currents carrying air pollutants from other areas and trapping them in Bangkok. He thinks motorcycles have a big impact on the environment in Bangkok because most of the vehicles on the road are motorcycles. They use damaging fuel sources (petrol), like cars do. Maybe they are less damaging individually, but the problem is the overwhelming number of them. The problem of excessive emissions of motorcycles and cars, he assumes the time ridden on a motorcycle is shorter than the time driving a car. Motorcycles have an easier time moving around because of speed and size. They can get through traffic faster, making travel time shorter, while cars get stuck in traffic and keep emitting fumes. Cars might be worse because there are a lot of them. Even if there are more motorcycles, they might produce less fumes and use less fuel than cars

individually. And motorcycles may have shorter travel time, decreasing the output. The newer motorcycles are more fuel efficient than older models. They might leak less too. Stronger state initiatives should be put in place. The state should be proactive in handling and managing these issues and the government should regulate the activities of the private sector to control waste.

Miss.Janissa Ak-karaaphichart and miss.Yanin Taiyanona are both sophomores studying in faculty of arts. They are classmates and good relationship friends but share some different opinions in some questions.to make it easier,I will use their nick name star and sunny to instead. Star paid her attention to the smog problem in Bangkok during this January quite a lot because it was really serious and it effected to her health and sunny did keep track of the news and wear pm2.5 resistant sanitary masks every day. Star think there are many causes of environmental pollution in Bangkok but mostly is that the government does not pay enough attention to environmental issues. Star thinks the main source of air pollution is Vehicle emissions and sunny thinks are vehicle emissions and industrial waste gas pollution. Star thinks motorcycles have a big impact on the environment in Bangkok because there are many motorcycles on the road in Bangkok that had environmentally unfriendly two-stroke engines. Sunny also agree because one of the main vehicles that Thai people use in daily life transportation is motorecycle and lots of motorcycles are not strictly controlled by the government.Many motorcycles on the road in Bangkok are not in good conditions such as broken engines that create black smoke and people do not use public transport as much as they supposed to so the more they use motorcycles, the more pollution stays in the air cause the air pollution in Bangkok. Sunny thinks the problem of excessive emission of cars is more serious because she thinks that there



are more cars than motorcycles on the road in Bangkok so it tends to have more car in bad conditions than motorcycles. Star also think so because even though there are more motorcycles than cars in Bangkok but the amount of pollution cars release is more than twice of the motorcycles' especially very old cars. Sunny thinks there are improvements to reduce the pollution of motorcycles to the environment such as using more electric motorcycles while star thinks government should strictly control amount of motorcycle sold in a year and remove too old motorcycles out from using. Sunny thinks there is no exact way to stop pollution as long as people are using resources as our daily life use. The only thing people can do is to reduce the usage of resources and focus more on clean and star says everyone especially the government have to pay more attention to fix the problems together. Finally,star thinks we should improve environmental protection laws and regulations develop more stringent environmental quality standards increase investment in environmental protection funds and supervise corporate governance pollution. Sunny offer many ways to strengthen environmental protection. Like improve environmental protection laws and regulations,develop more stringent environmental quality standards,increase investment in environmental protection funds,supervise corporate governance pollution and encourage public participation in environmental activities.



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<sup>6</sup> The writer with interviewers sunny and star in Chulalongkorn university

## Conclusion and recommendation

### Author's opinion

Through the analysis of the chart, we can conclude that the emissions of automobiles have a great impact on air pollution. Through interviews, I further analyzed the impact of motorcycle emissions on pollution is important or not. Some interviewers believe that the reason for motorcycles is very important, but many people think that other reasons are more important. They probably account for half each.

In my opinion, as a commonly used vehicle in the city, motorcycles have no impact on the environment is impossible. But how many percentage of its impact on pollution is very difficult to quantify with data. But if we want to improve the whole environment, we must reduce pollution as much as possible in every aspect. So how to solve motorcycle pollution is also a problem we cannot ignore.

For people in Bangkok, their lives will be hard without motorcycles. Because except using motorcycles as a transportation, people will use it to buy lunch or delivery things. In Bangkok, there are many motorcycle centers and we call them “win” in Thai. We can start to solve the problem from “win”. For example, better management motorcycle centers to maximize motorcycle efficiency. Promote electric vehicles among them or motorcycles that are as small as possible is also a good way.



## Recommendation to reduce air pollution

During the 1990s, when Bangkok smog was at similar hazardous levels, Thailand's Ministry of Natural Resources and Environment took steps that eliminated lead in fuel, imposed stricter emissions controls based on European Union standards, and most impressive of all, regulated construction sites despite opposition from powerful oil refineries and the automobile industry. If effective action was possible then, it should be possible again now. A number of excellent measures have already been mooted by media, academics and civil society in recent weeks. Here's a quick list of ten things that the government should do to immediately improve this situation.

1. Treat air pollution as a public health crisis. Simply waiting for the hot season to clear the smog is not responsible public policy. The urgency is for the government and its agencies, along with public and industry cooperation, to act now to implement both short and long-term solutions to improve air quality and livability in our city.

2. Reduce the number of cars on the road. Incentive area-based car-sharing

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<sup>7</sup> Bangkok 'win' riders : <https://images.app.goo.gl/pT74suGTfeHc3wvH8>

models. Mandate and enforce car-free days and pedestrianize all areas that are easily accessible via the BTS and MRT, to demonstrate that life is possible without driving. Start with Sundays, as Paris has done. In the medium to long-term, redesign roads to make room for large pavements and cycle lanes, so that cycling becomes a key form of urban transport along with other public transport like buses and trains. Devise a policy on electric vehicles (cars, motorbikes, bicycles, scooters and tuk-tuks) and start promoting them as viable transport alternatives.

3. Incentive the use of public transport. This also means increasing the capacity of existing mass transit -- including adding more train carriages and putting in more ticket barriers to reduce congestion in stations. Bangkok will see a number of new train lines come into operation in the coming years, so changing habits now will mean that more people will use mass transit for daily life rather than their cars. Introducing the long-delayed one-ticketing system or providing tokens for people who park their cars can be further incentives. Integrate Park and Ride infrastructure at terminal stations of train lines and offer free parking for commuters. Renew the public bus fleet towards modern efficiency standards replacing old diesel engines.

4. Require motorists to use more fuel-efficient cars with better fuel quality or alternative fuels to diesel. Improved petrol and diesel standards can help facilitate the adoption of better, cleaner emissions control technology, and reduce pollution and vehicle emissions. For example, European emission standards that define mandatory limits for exhaust emissions from new vehicles sold in the EU and member states. Electric cars could be one solution, albeit a limited one as they end up occupying the same road and parking space, and lead to increased electricity consumption.

5. Focus on reducing large vehicle traffic, particularly trucks with diesel engines and inefficient combustion. Enforce regular vehicular checks and make their movement highly regulated so that they are not crisscrossing the city during the weekdays.

6. Every December onwards, fields in per-urban Bangkok start showing large smoke plumes from waste incineration, unintended dump fires and burning of farm residue. Local community cooperation is crucial to prevent these burning in per-urban Bangkok. Provide better waste management options so that burning is not the go-to solution.

7. Existing standards for factory pollution and construction sites need stricter enforcement. The PCD is a small agency -- bring in other state agencies and police teams to assist the PCD to inspect and shut down construction sites that fail pollution standards. The threat of shutdowns could inspire big construction companies, who prefer to pay pollution fines and continue with construction, to clean up.

8. Mandate schools to restrict outdoor play and exercise on poor air quality days, as Seoul has done. Remember, there is no safe limit for exposure. Educate teachers, parents and children about the dangers of poor air quality and the potential for lifelong respiratory problems.

9. Provide masks and health care to the most affected and vulnerable people in Bangkok. The poor and marginalized (especially daily-wage labors) are burdened with the worst impacts as they work in the streets for their livelihoods. These include construction workers, guards, motorcycle, tuk-tuk and bus drivers, commuters on non-air-conditioned buses, street food vendors, maids and sweepers. Employers should be

required to provide their staff with adequate protective equipment.

10. Stop telling people to not panic. People feel the effects of the haze from piercing headaches to burning lungs and allergies while the solutions offered are vague at best. Provide clear information, share data, address concerns publicly. In a welcome move, Thailand's PCD has set-up many large LCD screens around Bangkok showing pollution levels with red alerts, but more efforts are possible, and we can learn from other countries. The "Breathe London" initiative by Mayor Sadiq Khan uses data analytic, sensors and maps to provide Londoners with a visual tool explaining their exposure to air pollution. China has fought air pollution with transparency, using publicly available data to create air pollution maps to highlight polluting firms and activities. Real-time disclosure helps both locate pollution spots and provide the public with useful information.

Of course, government regulation, the formulation of laws, the improvement of people's environmental awareness, more green areas and so on are all important measures to protect the environment. This requires the efforts of each of us. This is also the most important purpose of my writing this paper.

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# Appendix

## The questionnaire of interview

1. In January of this year, there was a serious smog problem in Bangkok. Do we understand or pay attention to this matter?
2. What do we think are the causes of environmental pollution in Bangkok?
3. What do we think is the main source of air pollution:
4. Do we think motorcycles have a big impact on the environment in Bangkok? why?
5. How pollution comes from motorcycles in Bangkok?
6. The problem of excessive emissions of motorcycles and cars, which one do we think is more serious? why?
7. Do we think there are any improvements to reduce the pollution of motorcycles to the environment?
8. How to stop the pollution happen again?
9. What areas do we think should strengthen environmental protection?

## VITA

<b>NAME</b>	Liang Canyu
<b>DATE OF BIRTH</b>	16 November 1996
<b>PLACE OF BIRTH</b>	China
<b>INSTITUTIONS ATTENDED</b>	Guangxi University
<b>HOME ADDRESS</b>	cuihouse



จุฬาลงกรณ์มหาวิทยาลัย  
CHULALONGKORN UNIVERSITY